PATENT SPECIFICATION (11) 1 541 976

(21) Application No. 5030/77 (22) Filed 8 Feb. 1977 (19)
(31) Convention Application Nos.
7 606 648 (32) Filed 9 March 1976
7 624 257 9 Aug. 1976 in
(33) France (FR)
(44) Complete Specification published 14 March 1979
(51) INT. CL.[2] F41F 5/02
(52) Index at acceptance
F3C 73

(54) RETRACTABLE TELESCOPIC EJECTOR FOR JETTISONING A LOAD FROM AN AIRCRAFT BY GAS THRUST

(71) We, R. ALKAN & CIE, of Rue du 8 Mai 1945, 94460 Valenton, France a French Body Corporate, do hereby declare the invention, for which we pray that a Patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

The present invention relates to means for ejecting or jettisoning loads from aircraft by utilizing the thrust produced by expanding gases, and has specific reference to an improved retractable telescopic device of this character.

The object of the invention is to provide a pneumatically-operated telescopic ejector in which the thrust applied to the telescopic elements remains relatively uniform over the ejector stroke even though the gas pressure exerted thereon decreases throughout the stroke and in which retraction of the telescopic elements is effected in an efficient manner.

According to the present invention we provide a retractable telescopic ejector for ejecting a load from an aircraft by gas thrust provided by a gas generator, in which the maximum pressure of the thrust gases from the gas generator is exerted during an initial phase of the ejection against a reduced surface area of a telescopic ejection piston and then, during a subsequent phase of the ejection after an initial extension of the telescopic piston and a predetermined reduction of the gas pressure, the reduced pressure of the thrust gases is exerted against an increased surface area of the telescopic ejection piston, said telescopic ejection piston being automatically retracted at the end of its ejection stroke, under the action of gases which are stored in a reserve chamber and are at least at the maximum gas pressure provided by the gas generator.

In order to afford a clearer understanding of this invention several embodiments thereof will now be described by way of example with reference to the attached drawings, in which:—

Figure 1 is a longitudinal axial section showing the device of the first form of embodiment in its retracted position;

FIGURE 2 is a similar section showing the same device with parts broken away, to illustrate the relative positions of the component elements after the first phase of the extension of the telescopic pistons;

FIGURE 3 is a longitudinal section (with various parts broken away) corresponding to the complete extension of the telescopic pistons and showing the relative position of the elements causing the subsequent retraction thereof;

FIGURE 4 is a fragmentary view showing a modified embodiment of the device illustrated in Figures 1 to 3;

FIGURE 5 is an axial longitudinal section showing the device according to a second form of embodiment, with its component elements in retracted position;

FIGURE 6 illustrates the device of Figure 5 after the first phase of the piston movements;

FIGURE 7 is a similar view showing the same device in its fully extended condition, and

FIGURE 8 is a view similar to Figure 5 but comprising an additional retarding seal.

Referring first to Figure 1, the reference numeral 1 designates the body of the device, 2 being an outer piston slidably mounted in a bore of the said body 1, an inner piston 3 being in turn slidably mounted in said outer piston 2. The inner piston 3 surrounds a hollow cylinder 4 secured to the upper end of the body 1, as shown. A hollow cylindrical spool valve 5 mounted in the lower end portion of piston 3 is adapted to vent to the free atmosphere and gas remaining upstream of the device, at the end of the ejection proper. An auxiliary cylinder 6 ad-

jacent the body 1 communicates via ports 7, 8 and 9 with said body. In this cylinder 6, another piston and spool valve unit 10, 11 is slidably fitted for constituting a distributor of compressed gases under the heads of the main telescopic pistons 2 and 3 and thus retract these pistons upon completion of their positive strokes or functions. This distributor piston 10 incorporates a valve 11 allowing the passage of gas from the very beginning of its supply to the device and at its maximum pressure into the annular chamber 12 formed between the auxiliary cylinder 6 and the stem 13 of distributor piston 10. A compression spring 14 constantly urges this piston 10 to its uppermost position, as shown in Figure 1. In this last-mentioned position, a circular groove 15 formed in the outer periphery of piston 10 causes the port 9 to communicate with the annular chamber 12 via ports 8 and 7.

The description of the device will now be completed by explaining the mode of operation thereof with reference to Figures 1 to 3.

The gases are supplied at their maximum pressure via a pipe line (not shown) to an inlet union 31 of body 1, and flow through a passage 16 of hollow cylinder 4 until they strike the reduced areas 17 closing the bottom of piston 3. The thrust thus produced is relatively moderate owing to the relatively reduced surface area involved. At the same time the gases force the distributor piston 10 back against the resistance of its return spring 14 and penetrate into the annular chamber 12 through the valve 11 holding said gases in reserve as illustrated in Figure 2, while the port 8, communicating with chamber 12 via port 7, is isolated from the circular groove 15 and therefore from port 9.

Due to the thrust exerted by the gases against the bottom of piston 3, the assembly comprising both pistons 3 and 2 is caused to slide in the body 1 and assumes the intermediate position illustrated in Figure 2.

A resilient member is provided for driving the piston 2 by means of piston 3 during the first phase of the extension but for allowing the piston 3 to move relative to the piston 2 during the subsequent phase of extension. This avoids a sudden impact between the first and second pistons during the subsequent phase, which impact would occur if piston 2 did not move with piston 3 during the first phase. This drive is obtained in this example in the form of a resilient seal or O-ring fitted in a circular groove 29 common to both pistons so that the elasticity of said ring, under the pressure exerted by piston 3, will enable the latter to continue its stroke when piston 2 abuts at the end of its stroke and of the first phase of the extension of the telescopic piston assembly.

In this position, the partially expanded gases exert their pressure on the entire cross-sectional surface area of piston 3, which may be twice the area 17 of the surface closing the bottom of that piston 3. This action takes place when the orifices 30 at the bottom of cylinder 4 are uncovered by piston 3.

It is clear that the pressure drop is compensated by the increment in the surface area against which the gas pressure is exerted and a thrust substantially equal to the initial thrust is provided while avoiding the inconvenience of an excessive initial thrust and preserving the same efficiency of the ejection device.

When the load has been ejected and separated from the device, the bottom spool valve 5 assumes the position shown in Figure 3, thus venting to the free atmosphere the residual gases retained upstream, and the auxiliary or distributor piston 10, urged by spring 14, resumes its initial position shown in Figure 1. The high-pressure gas reserve stored in annular chamber 12 communicates via orifices 7, 8 and 9, and also via annular groove 15, with the lower surface 18 of the head of piston 2 which resumes its uppermost position (Figure 1) while carrying along the inner piston 3. Through the orifice 19 formed in piston 2 adjacent the lower end thereof, the reserve gas will then exert a pressure also against the lower surface 20 of the head of piston 3, whereby the latter will also resume its uppermost position shown in Figure 1.

Since piston 3 must slide both in piston 2 and on the hollow cylinder 4 without any undue play, a slightly floating sealing member 21 is provided, this sealing member 21 oscillating about a resilient intermediate seal 22 between part-spherical seats 23, 24 retained by a nut 25. A skirt 26 integral with said member 21 and an upper flared portion 27 of piston 3 are designed with a view to ensuring the proper alignment and sliding movement of piston 3 on said sealing member 21.

To facilitate the understanding of the general mode of operation of the device, the latter has been described hereinabove as comprising a gas reserve for retracting the pistons. Similar devices have already been disclosed in prior patents held by the same Applicants. However, in this invention, the relative arrangement of the component elements and their combination with the main device differ somewhat.

Figure 4 illustrates a device based on the same principle the description of which, therefore, is not deemed necessary. However, its construction differs. To simplify the construction, the sealing member 21 is replaced by an olive-shaped member 32 on

which the piston 3 can slide with the minimum play.

For properly aligning this olive-shaped member 32, which is screwed to the bottom end of hollow cylinder 4 with respect to the piston 3, there is provided a ball and socket unit 33 of which the male spherical portion or ball 34 consists of the upper end of cylinder 4 and the female counterpart or socket 36 is screwed in the body 1. A screw plug 35 keeps the cylinder 4 in position while permitting by proper fitting the free oscillation thereof without any appreciable play. This oscillation is limited by the presence of a circular heel formed on said socket member 36, so that when the piston 3 moves upwards the olive-shaped member 32 is centered sufficiently to enable its tapered portion 37 to engage without any difficulty the matching flared portion 27 of piston 3.

The very slight gas leakage upwardly around the member 32 resulting from the absence of actual seals causes a small pressure within the body 1, which pressure is sufficient for producing the downward stroke of piston 2 without resorting to a resilient seal such as 28. This pressure is however negligible in comparison with the considerable pressure which moves the piston 3. Moreover, the arrangement illustrated in Figure 4, due to the reduction in the diameter D of the olive-shaped member 32 and the corresponding reduction in the diameter D of the bore of piston 3, affords a greater discrepancy between the initial surface area (bottom of piston 3) receiving the gas pressure and the final surface areas (i.e. the total cross-sectional area of said piston 3). Thus, the efficiency of the device is improved while providing a constant thrust.

The device illustrated in Figures 5 to 8 is directed to provide the same result through the same general means, namely an initial reduction of the surface area receiving the ejection pressure. In the form of embodiment illustrated in Figures 1 to 4 the initial pressure is exerted on one fraction of the inner piston, thus requiring some means for driving the outer piston with the inner piston during the first phase, in order to avoid a sudden impact between the the inner piston and the outer piston during the last phase of operation of the device. The modified structure shown in Figures 5 to 8 is directed to produce satisfactorily the initial stroke of both pistons without any initial shift therebetweep, and therefore without any detrimental subsequent impact. For this purpose, in the device illustrated in Figures 5 to 8 the full gas pressure is exerted during a first phase against the annular cross-sections of these two pistons which are thus driven simultaneously, whereas in the second phase the gas pressure is exerted, in addition, against the bottom of the central piston.

In Figure 5, there is shown diagrammatically at 41 the body of the device in which a piston 42 is adapted to slide, another piston 43 being furthermore adapted to slide in said piston 42. Secured to the upper portion of said body 41 is hollow central cylinder 44 comprising a valve, for example in the form of a ball 45 urged by a spring 46 against its seat 47. The reference numeral 48 further denotes a gas inlet and 49 denotes a passage permitting the communication between the hollow central cylinder 44 and the annular cavities 50 and 51 located under the heads of pistons 42 and 43, respectively. A spool valve 52 constantly bearing with its head 53 against the load to be ejected or jettisoned is shown in its initial position. Seals 54, 55, 56, 57 and 58 are also shown.

In Figure 6, the two pistons 42 and 43 are shown in the position attained simultaneously thereby at the end of the first phase of their extension. Piston 42 engages the screw plug 59 at the base of body 41, piston 43 has moved down beyond the seal 56 on the outer periphery of cylinder 44, and the gases can thus exert their pressures against the bottom 60 of the central piston 43.

In figure 7, the device is shown in its fully extended condition when the load has been ejected, and the spool valve 52 vents to the free atmosphere any residual gas. The gases under the maximum pressure, kept in reserve in the central cylinder 44, exert a pressure against the outer surface of the head of outer piston 42 in order to retract the latter, and then, after the return stroke of this outer piston, this gas pressure will be exerted from underneath against the outer portion of the head of the central piston.

In Figure 8 there is shown an additional seal 61 adapted to retard if necessary the flow of gases towards the central cylinder 44 and the annular cavities 50 and 51 underlying the piston heads. This seal 61 disposed around the upper portion of cylinder 44 may be released as a consequence of the downward stroke of pistons 42 and 43.

The operation of the device illustrated in Figures 5 to 8 is clearly apparent from the drawings and may be briefly explained as follows. The gases penetrating through the union or like inlet port 48 exert their pressure simultaneously against the heads of pistons 42 and 43, and flow into the reserve chamber formed within cylinder 44 via the path shown by the arrows in Figure 5, thus lifting the ball valve 45. This chamber retains the gases at their highest pressure due to the non-return function of ball valve 45, and communicates via passage 49 with the pair of annular cavities 50 and 51 controlling the retraction of both pistons 42 and

43. The maximum pressure is thus exerted against the upper annular surfaces 42A and 43A of pistons 42 and 43, respectively, and also against the annular surfaces provided under the heads of these pistons. To sum up, the initial useful surface area is reduced to the difference between the sum of the annular surfaces 42A and 43A, and the annular surface 50A under the head of piston 42.

It will be noted that the gas pressure is exerted simultaneously on both pistons and that these pistons can only move down simultaneously. When the head of piston 42 abuts with its surface 50A the edge of plug 59 (this movement being somewhat damped, due to the pressure prevailing in cavity 50) the piston 43 is positioned beyond the seal 56 as shown in Figure 6. Consequently, the gases partially expanded during the first phase of the stroke will exert a relatively reduced pressure against the bottom 60 of piston 43, and the additional useful surface area thus available will compensate for the pressure drop.

As already mentioned in the above description of the structure shown in Figures 1 to 4, when the load has been ejected and separated from the device the spool valve 52 tends to assume the position illustrated in Figure 7, thus venting to the free atmosphere the residual gases retained upstream. The reserve of gas under maximum pressure will then perform its usual function by pushing the heads of pistons 42 and 43 from underneath, thus retracting these pistons in succession until they resume the positions in which they are illustrated in Figure 5.

When certain gas generators are used, the maximum pressure is attained only after a predetermined piston stroke. Therefore, to obtain as usually required a thrust having the maximum regularity, it was found adequate to produce the counter-pressure under the piston heads only when the gas pressure tends to attain its maximum value. For this purpose, a complementary seal 61 (Figure 8) is contemplated in the above-described device, for preventing the gases from progressing along the path shown in Figure 5, as long as the pistons have not been moved to a level below the aforesaid seal 61. Then, the gas flow may take place for operating the device as described hereinabove with reference to Figures 5 to 7.

Although specific forms of embodiment of this invention have been described and illustrated herein, it will readily occur to those conversant with the art that various modifications and changes may be brought thereto without departing from the basic principles of the invention as set forth in the appended claims.

WHAT WE CLAIM IS:—

1. A retractable telescopic ejector for ejecting a load from an aircraft by gas thrust provided by a gas generator, in which the maximum pressure of the thrust gases from the gas generator is exerted during an initial phase of the ejection against a reduced surface area of a telescopic ejection piston and then, during a subsequent phase of the ejection after an initial extension of the telescopic piston and a predetermined reduction of the gas pressure, the reduced pressure of the thrust gases is exerted against an increased surface area of the telescopic ejection piston, said telescopic ejection piston being automatically retracted, at the end of its ejection stroke, under the action of gases which are stored in a reserve chamber and are at least at the maximum gas pressure provided by the gas generator.

2. An ejector according to Claim 1 wherein the passage of said thrust gases towards the ejection piston takes place via a fixed hollow central cylinder adapted to direct said gases against the bottom of the ejection piston which is hollow.

3. An ejector according to Claim 1 or 2, said hollow cylinder comprises a sealing member adapted to move slightly to permit its alignment with the movable ejection piston which is adapted to slide against the outer surface of said sealing member.

4. An ejector according to Claim 2 including a second outer hollow piston within which the ejection piston is slidable, the second piston being driven relative to said hollow central cylinder in conjunction with said ejection piston until the second piston abuts the ejector body during the initial phase, the ejection piston continuing to move on its own during the subsequent phase.

5. An ejector according to Claim 2, 3 or 4 wherein the disengagement of said ejection piston from said central cylinder enables the gas pressure to be exerted on the entire cross-sectional surface area of said ejection piston during said subsequent phase.

6. An ejector according to Claim 1 wherein the thrust gases are caused to flow towards the ejection piston via a hollow central cylinder pivoted at its upper portion and comprising at its lower portion a generally olive-shaped member slidably engageable by said ejection piston, which is hollow, until the latter is released from said central cylinder.

7. An ejector according to any one of the preceding claims, wherein said reserve chamber encloses a spring-loaded piston with an inlet valve capable of initially retaining high pressure gas from the gas generator.

8. An ejector as claimed in Claim 1 comprising an outer hollow piston and a central hollow ejection piston, the pressure of said gases being exerted during the first phase of the extension of the ejector against upper annular portions of the pistons and,

during the subsequent phase, additionally against the bottom of said central ejection piston.

9. An ejector according to Claim 8 in which a central hollow cylinder is provided which has the dual function of acting as said reserve chamber for storing gas under maximum pressure, which communicates with annular cavities provided under the piston heads, and as a support for a sealing system which, during the first phase of the extension of said pistons, prevents the gas pressure from acting against the bottom of said central ejection piston.

10. An ejector according to Claim 9 in which an additional seal mounted on the central cylinder prevents the gases from penetrating into said reserve chamber and into the cavities provided under the heads of said pistons until the latter has accomplished a predetermined partial stroke.

11. An ejector as claimed in claim 1 substantially as described hereinabove with reference to, and as shown in, Figures 1-3, or the modification of Figure 4, or Figures 5-8 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1979. Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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SHEET 1

Fig:1

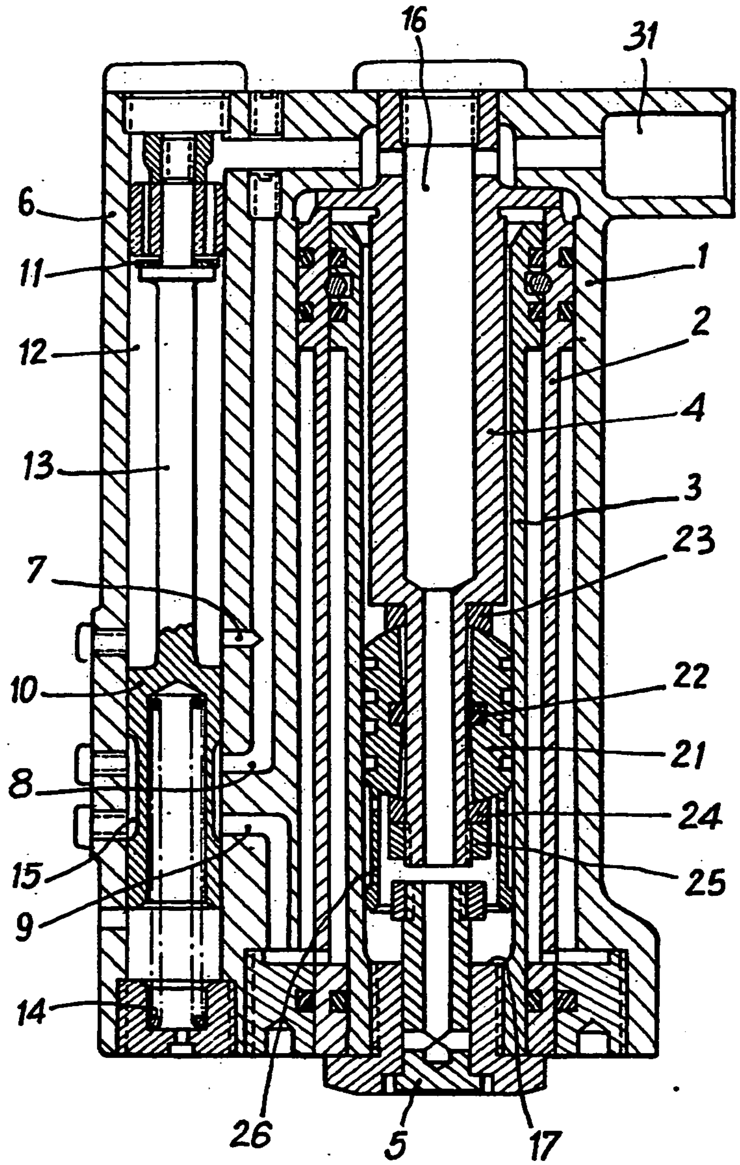
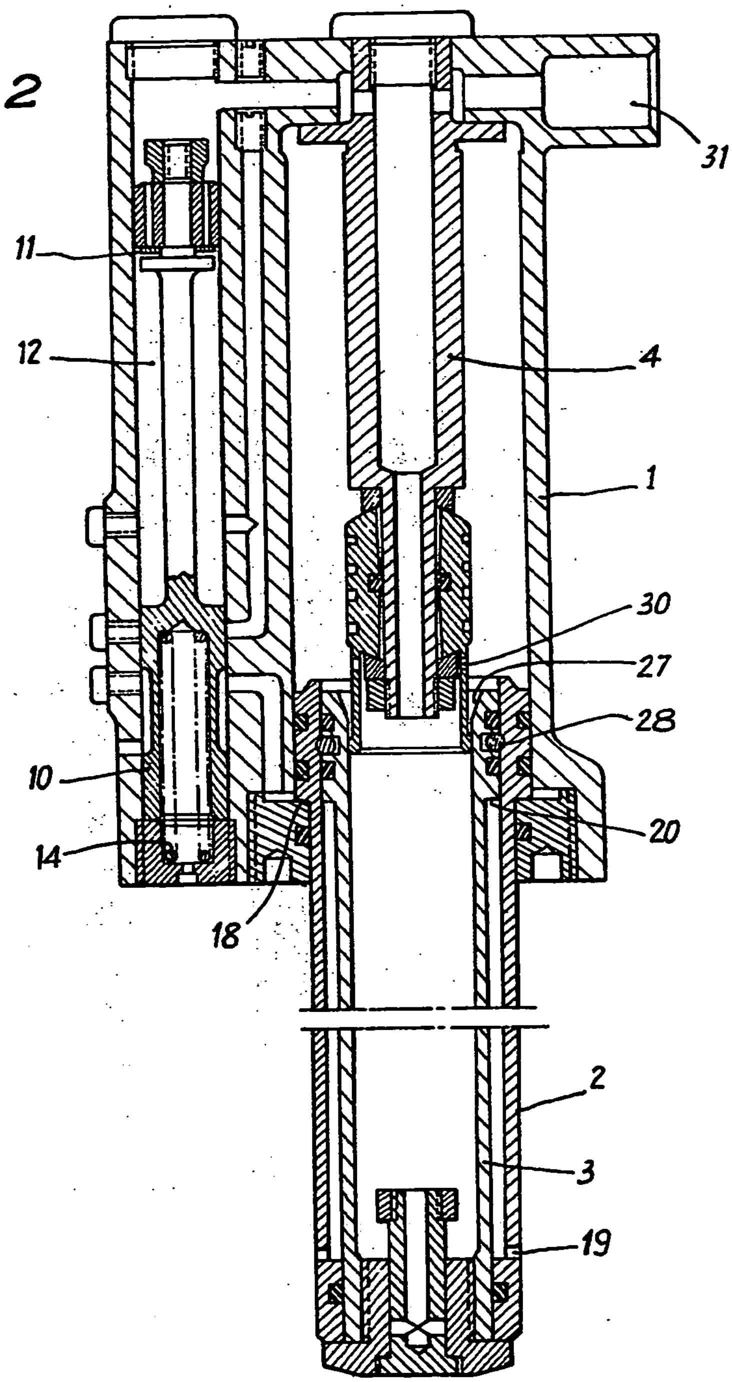


Fig: 2



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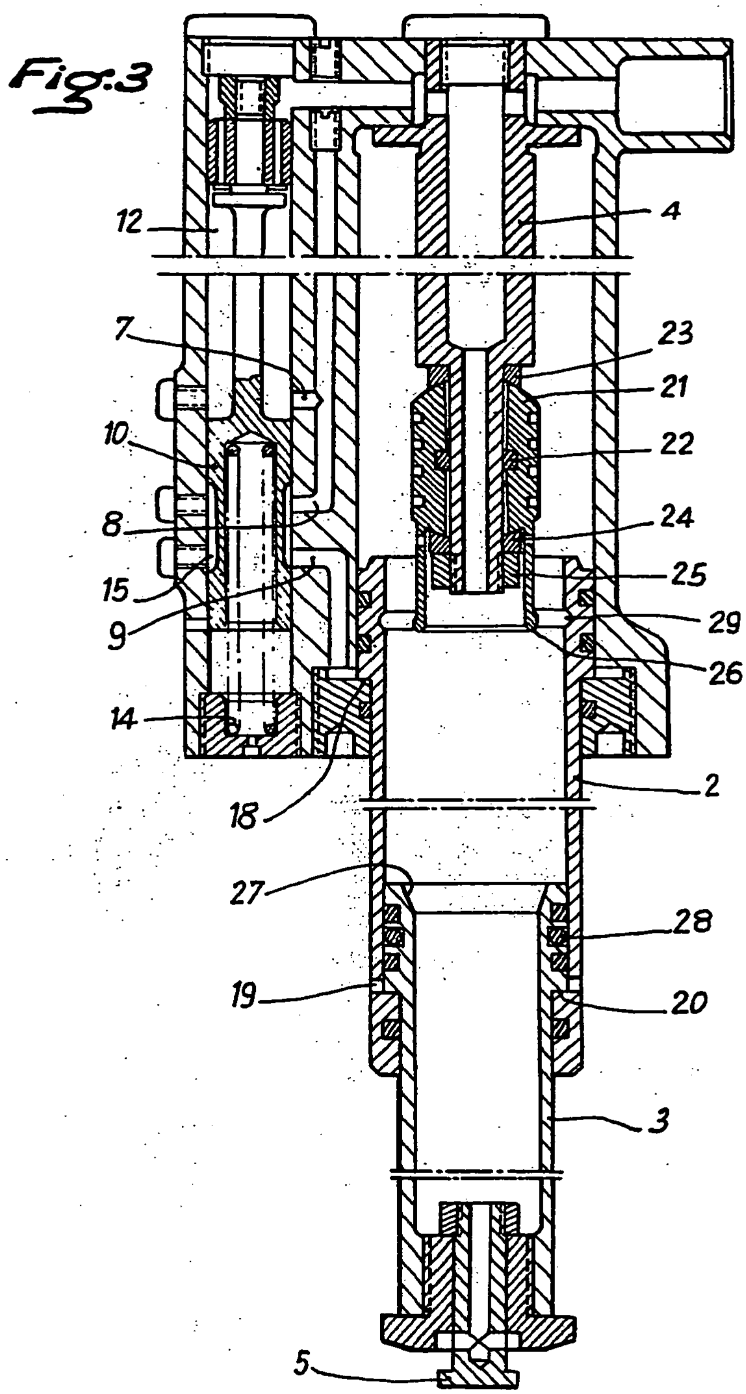

Fig.4

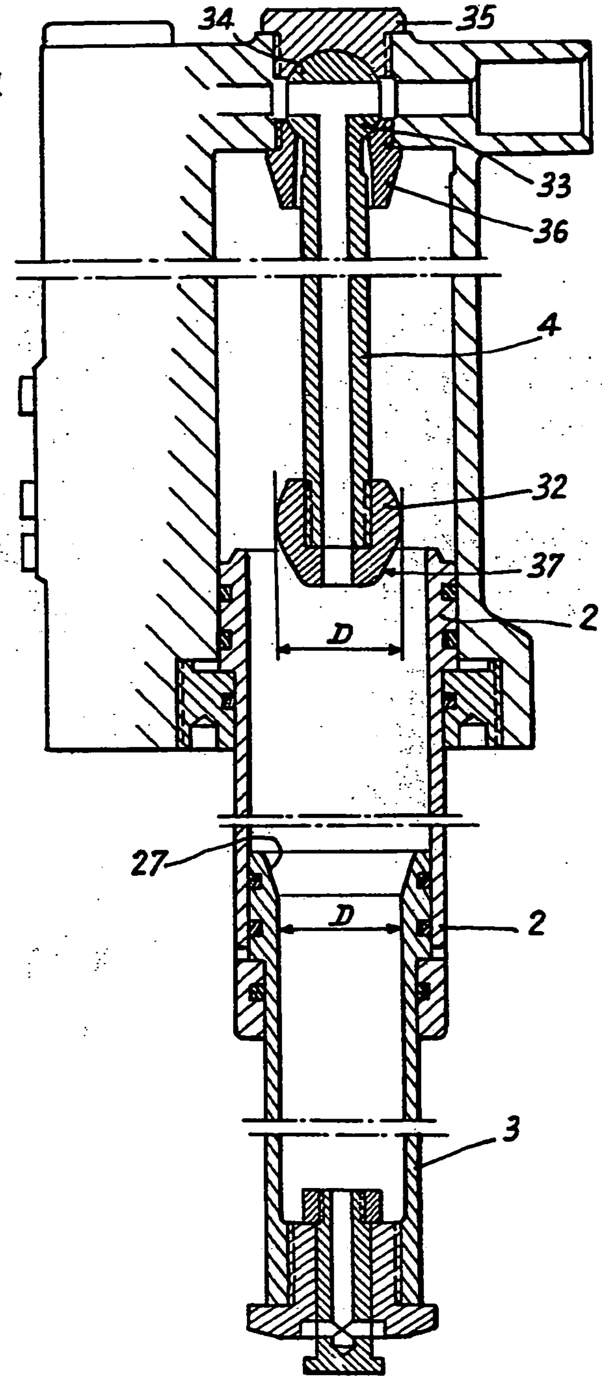

Fig:5

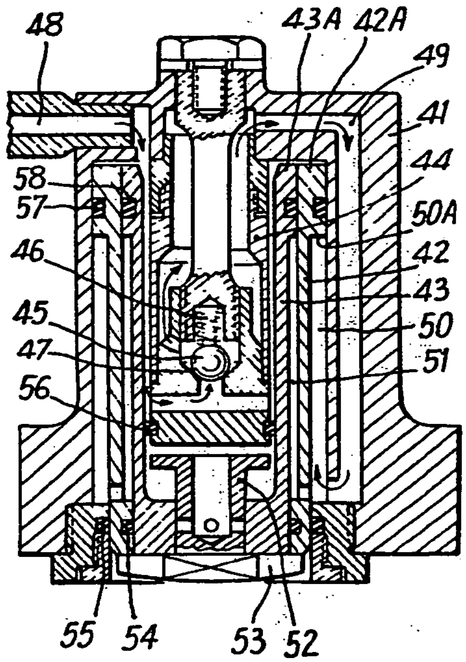
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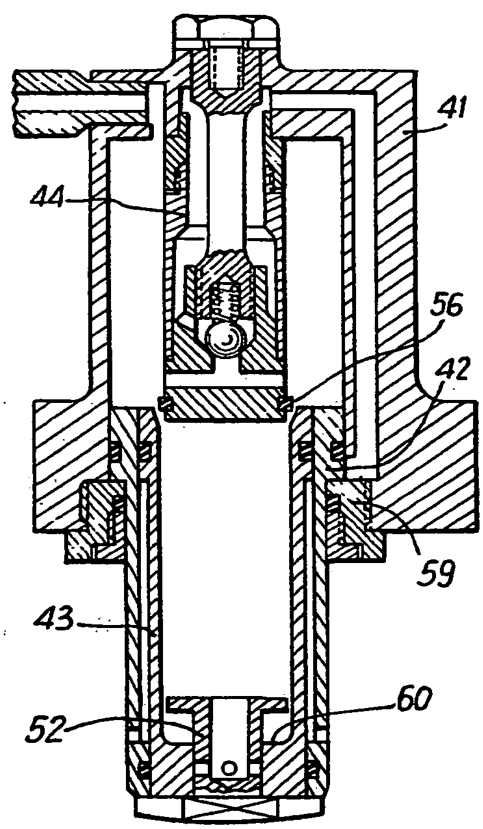
Fig:6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SHEET 6

Fig. 7

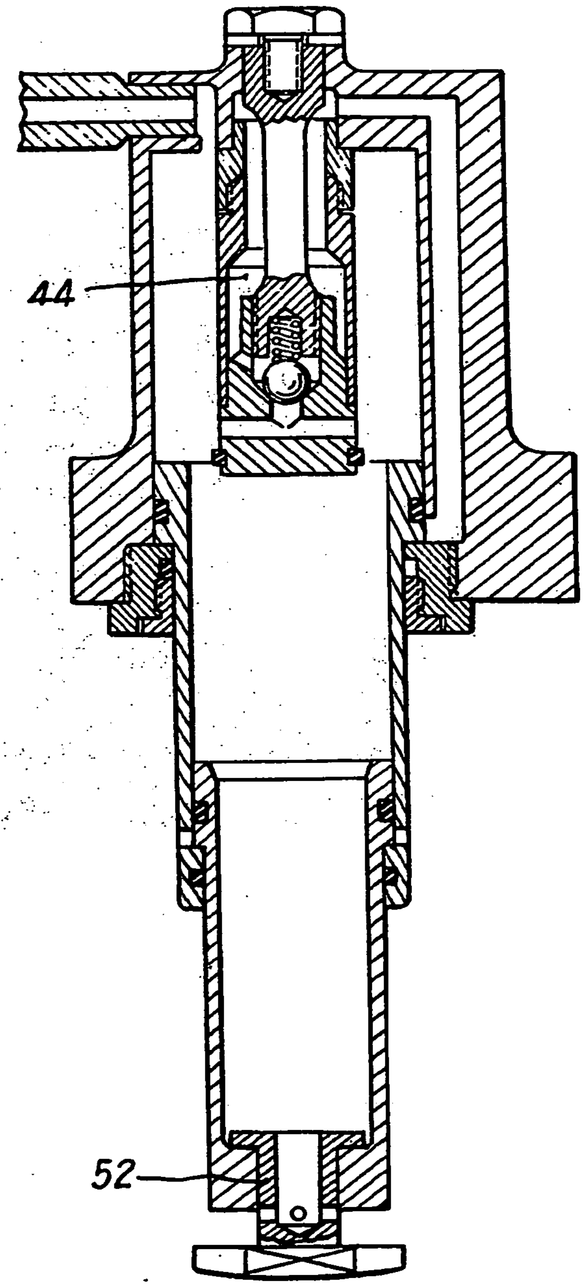
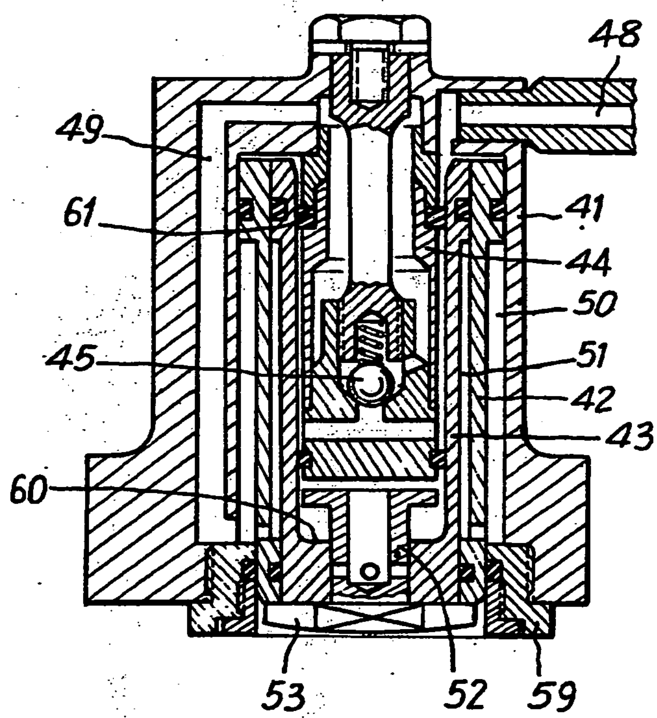


Fig:8



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